Published in final edited form as:

Arch Phys Med Rehabil. 2010 February ; 91(2): 318–320. doi:10.1016/j.apmr.2009.10.010.

Ulnar Neuropathy With Normal Electrodiagnosis and Abnormal Nerve Ultrasound

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Abstract

Ulnar neuropathy at the elbow (UNE) is the second most common entrapment neuropathy. It is diagnosed with electrodiagnostic studies, but they can yield false-negative results. Ultrasound was used to examine 4 patients with UNE and negative electrodiagnostic findings, and it showed ulnar nerve enlargement near the elbow in all cases, with a mean cross-sectional area of 20.1mm². This indicates that ultrasound may be a useful tool for assessing those with UNE symptoms and normal electrodiagnostic findings.

Keywords

Case report; Electromyography; Nerve conduction studies; Rehabilitation; Ulnar neuropathies; Ultrasonography

Ulnar neuropathy at the elbow is the second most common entrapment neuropathy of the upper extremity and is thought to most often occur from compression of the nerve within the cubital tunnel.¹ Typical findings include paresthesias in the 4th and 5th digits and weakness of ulnar innervated muscles,² and it is usually diagnosed by a combination of clinical findings and electrodiagnostic abnormalities. The sensitivity of electrodiagnosis for UNE (78%)² is much lower than for median mononeuropathy at the wrist, and there are reports³ of patients with normal electrodiagnostic findings having clear clinical signs and symptoms of UNE. The reasons for false-negative electrodiagnostic results are not always known but may include improper elbow position and ulnar nerve dislocation, which result in inaccurate nerve length measurements.⁴ Early or mild ulnar nerve involvement may also explain some false-negative results.

High-resolution ultrasound is an emerging tool for the evaluation of neuromuscular conditions, and several studies^{5–8} have evaluated the use of this technique in entrapment neuropathies.

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Presented as an abstract to the American Association of Neuromuscular & Electrodiagnostic Medicine, September 17–20, 2008, Providence, RI.

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

Focal ulnar nerve enlargement in patients with electrodiagnostically confirmed UNE has been demonstrated and shown to have high specificity,^{6,8} but ultrasonographic cross-sectional enlargement in patients with UNE and normal electrodiagnostic findings has not been reported. This study describes ultrasonographic nerve abnormalities in 4 patients with clinical findings consistent with UNE but normal electrodiagnostic findings.

Methods

Patient Identification

All patients in this study presented to the Diagnostic Neurology Laboratory at Wake Forest University School of Medicine between January 2007 and January 2008 and were referred for UNE. Inclusion criteria included paresthesias in the 4th and 5th digits, abnormal clinical sensory testing in the 4th and 5th digits and the dorsum of the ulnar aspect of the hand, and weakness in ulnar-innervated intrinsic hand muscles, all of which had to be present. All participants underwent electrodiagnostic studies and ultrasound, which is routine in our laboratory. Etiologies other than UNE, such as cervical radiculopathy, were excluded by using electrodiagnostic studies.

Electrodiagnostic Studies

All patients underwent NCS and electromyography for UNE, as described by Kimura.⁹ Extremities were warmed to 32°C by using a heating pad. NCSs included ulnar antidromic sensory; ulnar orthodromic motor stimulating at the wrist and below and above the elbow; recording from the abductor digiti minimi; and median sensory and motor studies. Electromyography was performed with a monopolar needle.

Ultrasonographic Studies

All 4 patients underwent ultrasound with an 18-MHz linear array transducer.^a The course of the ulnar nerve, from the wrist to the axilla, was examined. Cross-sectional area measurements were made of the ulnar nerve distal and proximal to the medial epicondyle and at the point of maximal enlargement near the medial epicondyle. The cross-sectional measurements were performed by using the trace function of the ultrasound device and tracing just inside the hyperechoic rim of the nerve.

Case Descriptions

Table 1 contains details from all 4 cases, but unique aspects were present in each case. Therefore, the cases are briefly described individually.

Case 1—A 50-year-old woman presented with several months of numbness. She had decreased sensation over digits 4 and 5 and 4/5 strength in finger abduction. Ultrasound showed marked enlargement of the ulnar nerve 1cm proximal to the medial epicondyle (26.7mm²). No comparison was made to the unaffected arm.

Case 2—A 56-year-old man who performed manual labor for 30 years presented with numbness in the right 4th and 5th digits for several years. He had sensory loss over the ulnar aspect of the right hand and 5-/5 strength in the FDI muscle. Ultrasound showed focal enlargement of the ulnar nerve (25.3mm²) just proximal to the medial epicondyle, and the nerve was hypoechoic at this site. No comparison to the unaffected arm was made.

^aSupplier: Biosound Esaote Mylab 25 device; Esaote Group, Genoa Via A. Siffredi, 58 16153 Genova Italy.

Case 3—A 28-year-old woman presented with 2 months of left 4th and 5th digit numbness after resting her elbow on a hard surface while playing a video game for several hours. She had sensory loss in an ulnar distribution and 4+/5 strength in the abductor digiti minimi and FDI on the left. Ultrasound showed enlargement of the ulnar nerve (12.3mm^2) at the level of the medial epicondyle, with a hypoechoic appearance. At the same site on the opposite side, the ulnar nerve cross-sectional area was 8.0mm^2 .

Case 4—A 30-year-old man presented with 3 months of right 4th and 5th digit numbness. He had a history of frequent computer use, up to 10 hours per day. He had 5–/5 strength in ulnar innervated muscles on the right. Ultrasound showed an increased cross-sectional area of the right ulnar nerve (16.0mm^2) at the medial epicondyle with a hypoechoic appearance. At the same site on the other side, the area was 7.0mm^2 .

Discussion

This is the first study to describe an increased cross-sectional area in ulnar nerves of patients suspected to have UNE but presenting with normal electrodiagnostic findings. In all cases, ultrasound of the ulnar nerve showed focal enlargement proximal to and at the medial epicondyle. In addition to absolute nerve enlargement, other changes were noted, including reduced echogenicity in 3 of the subjects and enlargement compared with the contralateral ulnar nerve. The mean cross-sectional area of the ulnar nerve was 20.1mm^2 , which is similar to patients with UNE and positive electrodiagnostic findings (19mm^2)⁶ and much larger than the reference values for ulnar nerve cross-sectional area around the elbow ($6.3\text{--}6.5\text{mm}^2$).¹⁰ We have previously identified swelling ratios, when the site of maximal enlargement is compared with distal and proximal nerve sites, of 2.8 to 2.9 in patients with UNE and positive electrodiagnostic findings,⁸ which is similar to the mean ratios in these patients of 2.97 to 3.06. The theory behind calculating a swelling ratio is that the nerve is only enlarged at a focal site, so a distant and presumably noninvolved nerve site is used as a comparison to the site of involvement, which allows for the calculation of a ratio.

We are aware of 1 previous study² in which nerve caliber changes were noted in patients with clinical evidence of UNE but no electrodiagnostic abnormalities. They studied ultrasound and electrodiagnosis in 102 patients referred to their clinic for UNE. They found 3 patients with sensory and motor signs consistent with UNE who had an increased ulnar nerve diameter but normal electrophysiologic findings.² Information on nerve mobility and echogenicity was not provided, but their findings are consistent with ours in that ultrasound can show changes in the nerves of those with UNE and normal electrodiagnostic findings.

Several factors lead to electrodiagnostic studies lacking sensitivity in UNE, especially when compared with median neuropathy at the wrist. First, measuring nerve length across the elbow can be challenging and may not be very accurate, particularly if the ulnar nerve moves with elbow flexion. It has been shown that 20.5% of ulnar nerves sublux during elbow flexion.¹¹ However, we did not note any subluxation in these patients so that likely does not account for their normal electrodiagnostic findings. Second, it is technically difficult to use some of the more sensitive NCS techniques, such as sensory or mixed studies, across the elbow because sensory nerve action potentials disperse more than motor with proximal stimulation. Third, it is possible that NCS of other ulnar nerve fascicles, such as those innervating the 4th digit or FDI muscle, could have increased the sensitivity of electrodiagnostic testing.^{12,13}

Ultrasound is a promising tool because it provides anatomic information not available with electrodiagnostic studies, and it is readily available, is inexpensive, does not involve radiation exposure, and is painless. A previous study¹⁴ showed ultrasonographic abnormalities in patients with clinical carpal tunnel syndrome and normal electrodiagnostic findings. Those

results, plus our findings in these patients, suggest that in certain settings ultrasound may provide a sensitive test to further evaluate those with negative electrodiagnostic findings.

Conclusions

This case series shows that some patients with UNE and normal NCSs show abnormalities when their ulnar nerves are examined with high-resolution ultrasound, including an increased nerve cross-sectional area. Further research into this topic is needed to determine the frequency with which this occurs.

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List of Abbreviations

FDI	first dorsal interosseous
NCS	nerve conduction study
UNE	ulnar neuropathy at the elbow

Table 1

Patient and Ultrasonographic Characteristics

Case #	Age	Sex	Side	Maximal Area	Distal Area Ratio	Proximal Area Ratio
1	50	Female	Left	26.7	3.81	4.45
2	56	Male	Right	25.3	3.47	3.29
3	28	Female	Left	12.3	2.32	1.95
4	30	Male	Right	16.0	2.29	2.54
Means	41	—	—	20.1	2.97	3.06

NOTE. This table shows the patient and ultrasonographic characteristics of the 4 patients with clinical UNE but no abnormalities on electrodiagnostic studies. The maximal area refers to the point of maximal enlargement of the ulnar nerve near the elbow as measured with the trace function on the ultrasound device. The distal ratio is the ratio of the point of maximal enlargement of the ulnar nerve to a cross-sectional area obtained from the distal ulnar nerve (at the midforearm level), and the proximal ratio is the same with comparison to a proximal cross-sectional area (at the midarm level).